

Implementation of STEAM-Based Project Learning Model to Improve Elementary Student's Learning Outcomes

R. Teti Rostikawati*, Sandi Budiana, Nita Karmila, Bintang Indah Saptiani, Nurmala Sari

Faculty of Teacher Training and Education, Universitas Pakuan, Bogor, Indonesia
rostikawati@unpak.ac.id*; budianasandi@gmail.com; nitakarmila@unpak.ac.id;
bintangseptiani08@gmail.com; snurmala1711@gmail.com;

*Corresponding author

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ABSTRACT

This research aims to determine how the implementation of the Science, Technology, Engineering, Art, and Mathematics-Based Project-Based Learning Model affects the learning outcomes of students in the sub-theme of project-based activities and literacy. The research method used was a quasi-experimental two-group design at one of Public Elementary School in Bogor City. The subjects of this study were fifth grade that consisting of 63 students. This research was conducted in the first semester. The results of the study showed that the implementation of the STEAM-based project-based learning model had an effect on student learning outcomes in the sub-theme of project-based activities and literacy. The results shows that N-Gain score in the experimental group is 69, while the control group obtained an N-Gain score is 39. The hypothesis testing results state that H_0 is rejected and H_a is accepted because t-count (14.56) is greater than t-table (1.9996). Thus, it can be concluded that the implementation of the STEAM-based Project-Based Learning Model effectively improves student learning outcomes in the sub-theme of project-based activities and literacy. It is hoped that the results of this study can provide new knowledge about how the implementation of innovative learning models can improve the learning outcomes of students in elementary school.

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Introduction

Education is very important for the life of a nation, and efforts must be made to develop it so that it is not left behind by development demands. Education can keep us abreast of current developments and changes in the fields of science, technology, socioculture, and economics (Zulkarnain, 2017). Education is not something static but something dynamic, so it demands continuous improvement. The world of education has goals that must be achieved in the learning process. Education not only emphasizes mastery of material but also mastery of skills. The teaching and learning process in education is an important aspect of improving the quality and progress of education (Zega & Novelina., 2023). Currently, the fact is that education in several schools sometimes still applies conventional learning models. This

learning model is quite commonly carried out, namely through the teacher giving explanations and students listening. This model is also more teacher-centered, thereby reducing the role and activities of students in learning. In order for the learning process to run effectively, teachers must guide students, and the use of varied learning models must be carried out in order to increase interaction between teachers and students in teaching and learning activities.

The learning model that is structured has interactions, and these interactions need to be taken into account. Therefore, this learning model cannot be replaced by another. The learning model is very effective in improving the quality of learning and teaching because learning activities encourage students to take an active role in learning, and it is hoped that students can think critically and encourage cohesiveness and how to work together with a team. Dewi et al. (2019) said that learning outcomes are the result of a process of behavioral change due to individual interactions between individuals and their environment, which is used as an experience. Meanwhile, according to Fitriyani *et al.* (2020), learning outcomes are the skills acquired by a person as a result of completing learning activities. Novita *et al.*, (2020) revealed the factors that learning outcomes are categorized into two, namely: internal factors which are divided into three factors, namely physical factors, psychological factors and fatigue factors. External factors that affect learning can be divided into three factors, namely family factors, school factors, and community factors. Meanwhile Nurrita (2018) said that learning outcomes are the results given to students in the form of assessments, assessments of knowledge, attitudes and skills when they are involved in the learning process with changes in behavior. According to Cahyadi *et al.* (2021), student learning outcomes can be determined by whether or not the learning objectives have been achieved.

Teaching in class V of SDN Bondongan in Bogor still does not fully use innovative learning models, so that students do not understand the material. Teachers tend to be more active in class, and students are given less space to be active and take initiative in the learning process. This causes young students to feel bored and tired during the learning process, feel less enjoyable, and easily forget the lessons delivered by teachers at school. The problems faced by the students had an impact on their learning outcomes, which were not yet optimal, with the number of students in classes V-A and B being 63, as proven by their Primary Learning Assessment (PTS) scores, which were still below the KKM.

In response to the fact that the KKM learning outcomes have not been achieved optimally and the learning model has not been implemented optimally, it is necessary to look for efforts to improve learning outcomes and students' ability to understand lesson material. One effort to solve this problem is to apply the project-based Science, Technology, Engineering, Art, and Mathematics learning model. Fitri *et al.* (2018) said that the learning model is one of the most important aspects of the learning process. The learning mode applied must be fun.

This aims to increase the enthusiasm of students for the implementation of learning and create a more active and enjoyable classroom atmosphere. The STEAM learning is to develop critical thinking skills. Rather than just memorizing theory from textbooks, children will be encouraged to more actively practice how to solve problems based on the understanding they already have. Another opinion put forward by Djonmiarjo (2020) is that learning modes are ways of presenting learning materials to students to help them achieve the goals that have been set. This project-based learning mode requires students to be active in solving problems by looking for an idea that can be generalized into a product as a result of project activities. According to Winangun (2021), the characteristics of this Project Based Learning model are a scientific approach that is able to meet the needs of

education in the 21st century by developing critical thinking skills, communication, cooperation, and collaboration. And technically it is done with simple practices that can provide a new learning atmosphere so that it can eliminate students' boredom. Meanwhile, according to Khodijah & Mulyaningsih (2023) the advantages of the STEAM approach in schools besides children showing the ability to recognize, understand various information, children are also able to be curious, children see cause-and-effect relationships and children can solve problems. Children can become more focused, think critically, and actively ask questions. Children can also explore what is in their environment in accordance with the development of increasingly sophisticated times. Likewise, learning is more fun, feels innovative and creative, the atmosphere is livelier, and children are enthusiastic and have more insight.

This research aims to evaluate the effect of implementing the project-based learning model based on science, technology, engineering, art, and mathematics on student learning outcomes in the sub-themes of project-based activities and literacy in elementary schools. Shodiqoh & Mansyur (2022) believe that the project-based learning model is an innovative learning model that supports students to be able to solve problems, make decisions, and carry out activities that can increase student creativity and motivation. Sheinita *et al.* (2022) STEAM is an inter-disciplinary integration that studies various academic concepts juxtaposed with the real world by applying the principles of science, mathematics, engineering, science, and technology. This research aims to evaluate the effect of implementing the project-based learning model based on science, technology, engineering, art, and mathematics on student learning outcomes in the sub-themes of project-based activities and literacy in elementary schools.

Method

The research method used is a quasi-experimental method. Research method that identifies differences in learning outcomes between the experimental class and the control class. The experimental group will receive treatment with the project-based learning model based on science, technology, engineering, art, and mathematics, and the control class group will receive treatment with the conventional model. The population in this study were students in classes V-B and V-C at SDN Bondongan, Bogor City, for the academic year 2022-2023. Data collection regarding learning outcomes in this research took the form of an objective test in the form of multiple choice with 25 questions. This data collection technique includes pretest and posttest assessments. Fitri I, (2020) revealed that the assessment carried out by the teacher aims to help clarify learning objectives informing students' strengths and weaknesses in learning; informing learners how to improve their learning process and results; essential information material to parents and the community regarding the effectiveness of school programs. The research instrument is a data collection instrument using pretest and posttest assessments, which will be defined conceptually, namely the dependent variable to be developed with an operational definition to prepare a grid of pretest and posttest questions. The question instrument is created based on a grid that has been determined after carrying out curriculum analysis. Next, a validity and reliability test are carried out, determining the level of difficulty of the questions and calculating the differentiating power of the questions to determine the increase in learning outcomes using N-Gain.

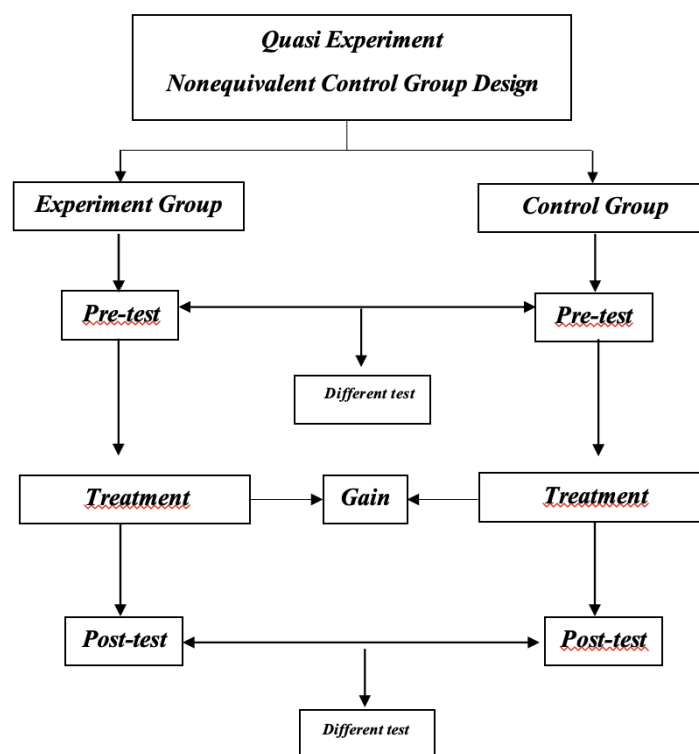


Figure 1. Flow diagram a quasi-experimental

Results and Discussion

The influence of the implementation of the project-based learning model based on science, technology, engineering, art, and mathematics on student learning outcomes in the sub-themes of project-based activities and literacy. A question-instrument test was carried out in class VI, which consisted of 40 multiple-choice questions. The research was carried out at Bondongan State Elementary School, Bogor City, in classes V-A and V-B, with class V-A as the experimental group and class V-B as the control group. The steps for implementing STEAM-based learning include the use of learning media such as videos and discussions, preparing project schedules, creating products, preparing reports, and evaluating. The research results show that the STEAM-based learning model has a positive impact on improving learning outcomes, with an average N-Gain of 69. This model also helps in developing critical and creative thinking skills and increases students' ability to solve problems. Even though it has several shortcomings, STEAM-based learning still has a significant positive impact on student learning outcomes.

The first step of research in the experimental class, which applies the project-based learning model, is to provide basic questions, where students are asked basic questions after observing video shows about problems related to the benefits of water. This attracts students' attention so that learning is not monotonous. As supported by Putri & Dewi (2020:33) that one way to increase students' interest in learning is by using learning media. Learning videos can be an effective learning tool for students. Quality learning will result in maximum student learning outcomes. By listening to and observing videos that are appropriate to the learning material, students can expand their sharpness and visualization abilities. After this

activity, students and teachers conducted questions and answers regarding solutions to problems related to material regarding project-based activities and literacy.

Next, the students discuss so they can find out the solution to the problems that have been determined in the lesson. The second step is that the teacher divides the students into 5 groups, consisting of 5–6 students. Then the teacher guides and directs the students by showing a video of the project that will be made, namely a simple water filtration device. Students have discussions with their group of friends regarding the design to be made, the tools and materials that need to be prepared, and the division of tasks for each group member. This activity encourages students to be able to think critically, creatively, and innovatively so that they can produce a good product. As stated by Hidayat (2021:18), the project-based learning model is a model that uses problems as the first step in learning and creates projects as the final step, with the aim of students being able to increase understanding, critical thinking, creativity, innovation, and positive activities. other. Students are also asked to solve the problem that was presented in the first step and collaborate with their group friends to create a project.

The third step is to prepare a project schedule. The teacher and students make an agreement that the project will be carried out the following day. After that, the students complete the design of the water filtration tool, which will be made in the Student Worksheet (LKPD), and then the students present the results of the design that has been discussed with group members and have obtained approval from the teacher. The design that has been mutually agreed upon in each group is then made into a product. Thus, each group carries out project activities the following day according to a predetermined schedule.

The fourth step is that the teacher monitors the activity and progress of the project carried out by students the following day according to the schedule. In this step, students begin to prepare tools and materials and study work procedures and project designs that have been prepared. Each group makes a project that has been designed with various types of materials prepared. Students are required to be careful in making the project, such as measuring the materials to be used, because, of course, each group uses different measurements of materials and the results will be different. This also includes the application of the STEAM approach, as stated by Harahap *et al.* (2021: 1055). STEAM is an approach to 21st century learning with a learning process that combines science, technology, engineering, mathematics, and art in the learning process. In this lesson, the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach is used, where when students filter dirty water, it is included in physical science, starting from filtering, deposition, absorption, and adsorption.

Then students also look for solutions to problems through technology by looking at how to make a simple water filtration tool and finding out the materials used in making a simple water filtration tool. Then, when students design a simple water filtration device, it is also included in art; of course, the designs from groups A and B are different. When designing a simple water filtration tool, it is also included in engineering, and finally, in designing this tool, students are also required to be able to estimate the materials that will be used, such as the amount of gravel, the amount of cotton used, and other materials. This is also included in the application of mathematics.

The fifth step is preparing reports and publishing project results. After the project is completed, students begin to prepare a report on the Student Worksheet (LKPD), and in compiling the report, after the report is completed, students are very enthusiastic and more active in presenting the project that has been designed, and each group has differences in the

results of their project. According to the opinion (Zuraida *et al.*, 2022:3), one of the advantages of this project-based learning model is that it trains students to think and act more actively through project assignments, students are cleverer at speaking and writing, and students can express thoughts and ideas so that they get project results best.

The sixth step is evaluating the project process and results. The teacher responds to the students' work results and provides feedback and appreciation. The students, together with the teacher, evaluate the project creation process, and the teacher provides reinforcement for the project results.

Then the teacher gives rewards to the best group, followed by the teacher and students together making conclusions from the lessons they have learned.

Based on the average pre-test score, average post-test score, and average N-Gain score obtained by the experimental class and control class groups, it can be seen that there are differences in the application of the STEAM-based project-based learning model in each class group. These differences can be seen in Table 1, and the histogram graph can be seen in table 1 below.

Table 1. Recapitulation of Average Values for STEAM-based Project Learning Model Class Groups and Conventional Model Class Groups

Value Recapitulation	Class Group		
	STEAM-Based Project Learning	Conventional	
Lowest value	<i>Pretest</i>	27.5	37.5
	<i>Posttest</i>	75	60
	<i>N-Gain</i>	57	11
The high score	<i>Pretest</i>	60	85
	<i>Posttest</i>	97.5	90
	<i>N-Gain</i>	95	71
Average value	<i>Pretest</i>	41.88	55.24
	<i>Posttest</i>	81.88	73.47
	<i>N-Gain</i>	69	39

Based on the recapitulation table of average values above, the histogram graph using the STEAM-Based Project-Based Learning model of learning outcomes for the Project-Based Activities, Literacy, and Conventional Activities subthemes can be seen in the following image:

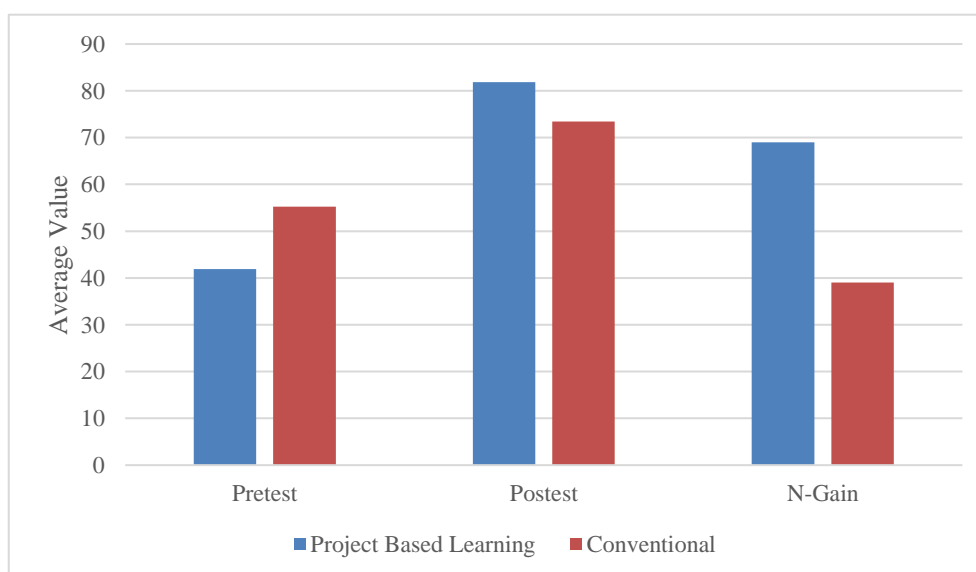


Figure 2. Histogram of STEAM-based Project Based Learning Model Class Groups and Conventional Model Class Groups

Based on the average N-Gain value of the STEAM-based Project-Based Learning model class group and the conventional model learning class group, the t-test results are presented in Table 2.

Table 2. T-Test Results Average N-Gain Class Group Project Based Learning and Learning Model based on STEAM and Conventional classes

Class Group	N	dk	N-Gain	T _{count}	t _{table}
Project Based learning	32	61	69	14.56	1.9996
Control	31		39		

Based on the research results that have been obtained, it is known that the average N-Gain score for learning outcomes for the sub-themes of project-based activities and literacy from the two research samples. It was found that there was a significant difference in the average N-Gain for learning outcomes between the STEAM-based project-based learning class group and the conventional class group. Based on the average N-Gain value of the experimental class group, which is 69, it is higher than the average N-Gain value of the control class group, which is 39. This shows that there are differences in learning outcomes in the sub-theme of project-based activities and student literacy in the class group. The project-based learning model is higher than the learning outcomes of students, as shown by the completeness of learning outcomes in the experimental class, which uses the project-based learning model, at 48%, and in the control class, which uses the conventional model, the completeness of learning outcomes is 3.5%. In accordance with Mutawally (2021:2)'s opinion, this project-based learning model can stimulate students' creativity, encourage students' potential and skills, and encourage students to be more active in the learning process, thereby improving students' learning outcomes. This shows that there is an increase in learning outcomes due to the application of the learning model in the experimental class compared to the learning outcomes in the control class. In line with research conducted by Muawana et al. (2018), it shows that there is an increase in learning outcomes in the experimental class group that uses the project-based learning model, meaning that the project-based learning model is more effective in improving student learning outcomes.

The results of the research above can prove that the increase in knowledge learning outcomes for each class is not due to coincidental factors but is caused by the presence of treatment factors in each class and of course, it is supported by determining factors such as the teacher's ability to process learning, such as the use of interesting learning media, appropriate and appropriate learning models, teacher readiness in delivering the material, students' readiness in receiving the material, and other things. Apart from this, the implementation of STEAM-based learning can improve students' skills in critical and creative thinking, as proven by being able to make products based on varied project designs, and the results are quite good and at the same time have an influence on the achievement of their learning outcomes. Apart from this, the learning process uses a variety of learning tools with interesting media and worksheets that require students to carry out activities in accordance with the material presented, discuss, and exchange opinions so that they are skilled in honing their thinking skills by solving problems and increasing their knowledge through searching. Learning resources by searching for supporting references can also improve psychomotor abilities. One of the varied learning models in the 2013 curriculum is the project-based learning model using the Science, Technology, Engineering, Art, and Mathematics (STEAM) approach. As stated by Shodiqoh & Mansyur (2022:145), the project-based learning model is a way of facilitating students' learning experiences by presenting children with everyday problems that need to be solved in groups. The problems

shown in this lesson are real problems that can happen to anyone. By carrying out this learning, students will gain direct experience solving problems that exist in everyday life.

The advantage of applying the project-based learning model in this research is that students can think critically and work together in designing and creating projects by developing several opinions so as to produce the best project. Besides that, students can also improve their writing and speaking skills by presenting project results in front of class. In line with the opinion of Zuraida *et al.* (2022:3), who reveal the advantages of the project-based learning model, namely teaching students to think about projects and work hard, knowing how to make products, and speaking and writing skills, students can express ideas and opinions to the team to achieve the best results from the projects undertaken.

As for learning using the project-based learning model in this research, it also has disadvantages, namely that the class is not conducive because of the students' enthusiasm, so that students become more active. With less conducive class conditions, it requires more time than the predetermined schedule. In line with the opinion expressed by Novianti (2021:646), learning using the project-based learning model has disadvantages such as students' active attitude, which can cause the class to become unconducive. Even though they have determined the time allocation for making the project, it will still waste time because the class is not conducive. According Sari *et al.*, (2023) The advantages of Project Based Learning are that it makes children excited when there are activities, allows children to understand the value of the benefits of products and works, increases independence in project-based learning as a whole, and can improve six aspects of child development.

Regardless of the advantages and disadvantages, the STEAM-based project-based learning model in elementary schools still has a positive impact on improving student learning outcomes. In this study, researchers concluded that the STEAM-based project-based learning model was more effective in improving learning outcomes compared to conventional learning.

Conclusion

The conclusion of this research is that the learning outcomes for the project-based activities and literacy sub-themes increase by using the project-based learning model based on science, technology, engineering, art, and mathematics for class V students at SD Negeri Bondongan, Kec. West Bogor, Bogor City, even in the 2022–2023 academic year. This can be seen from the N-Gain value in the experimental class group of 69%, while in the control class group the value was 39%. This shows that the project-based learning model based on science, technology, engineering, art, and mathematics is more effective in improving learning outcomes compared to conventional learning.

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